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THE EVALUATION OF SEEDBEDS, METHOD OF SEEDING, AND SPECIES FOR RESEEDING ARID RANGELANDS OF ARIZONA

Pima, Congress, and Fredonia Areas

A Progress Report for the Calendar Year

1967

submitted to

The Bureau of Land Management
United States Department of the Interior

prepared by

Gilbert L. Jordan
Department of Watershed Management
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PREFACE

The studies covered in this report were supported under a research contract between the Bureau of Land Management and the Agricultural Experiment Station, University of Arizona. This is a Progress Report submitted to the Bureau in partial fulfillment of that Contract. The material herein should not be used in other manuscripts without the permission of the above agencies. Many of the indications from the results of these studies are tentative and subject to modification from further research. Parts of these studies are also being utilized in the research programs of graduate students.

The cooperation of many persons is acknowledged: the personnel of the Arizona State and District Offices of the Bureau of Land Management have been most helpful and progressive in their actions. The Plant Materials Center, SCS, has aided in seed procurement. Project personnel consisted of Mr. R. Leslie Rawles, Assistant in Research; Mr. Richard Stevens, Graduate Assistant, and Mr. Melvin Wilhelm, Graduate Student.

Gilbert L. Jordan,
Project Leader

March 1968

SYNOPSIS

This is a progress report covering experimental range seedings at Congress, Pima, and Fredonia. The Congress area with an average of 3.8 inch of summer precipitation is believed to be too arid for the establishment of Lehmann lovegrass. Lehmann lovegrass has been the most drought tolerant species available for this area.

Lehmann lovegrass seedings at Pima have responded best on root plowed seedbeds. Besides removing competitive shrubs, plowing aids in the penetration of moisture. Pitting treatments have also been beneficial in this respect. Studies and improvements are needed to perfect pitting procedures and to circumvent competition from weedy annual grasses. To this end, different types of plowing and pitting at various times of the year are being studied. Other than Lehmann lovegrass, an experimental Boer lovegrass is promising for reseeding in this area.

Studies at Fredonia point out that plowing of sagebrush rangelands is the most effective for range seedbed preparation. Sagebrush control must be very thorough, however, because it competes too severely with seeded grasses. Herbicidal spraying of young sagebrush and globe mallow in recent seedings have doubled yields from crested wheatgrass and Russian wildrye. Successful seedings in this area can be achieved only with certain wheatgrasses - crested wheatgrass, siberian wheatgrass, and Luna pubescent wheatgrass.

Luna pubescent wheatgrass has been the most successful. Several other cool-season species appear promising and are under study for

ability to yield and to withstand utilization. Browse species are also being studied. Successful seedings of various species appears to be dependent on proper rate and depth of seeding which are currently under study. Unless an improved seeding procedure can be developed for Russian wildrye, it should be considered borderline for seeding in the Fredonia area.

THE CONGRESS AREA

No experimental studies were established at the Congress Area during 1967 but observations were made and data were taken on studies made in previous years. As indicated in previous progress reports and as observed during the summer of 1967, all seedings have responded very poorly. This was primarily due to inadequate summer precipitation in this area. On the 1964 and 1965 seedings the stand of seeded grass, Lehmann lovegrass, was very sparse, and no data were taken. On the 1966 seeding the plants were also very small, but a plant count was made on the various seedbeds. These data are presented in Table 1, and they indicate that root plowing was the most effective method of seedbed preparation. Root plowing accomplishes the apparent requirement of opening the dispersed surface soils and facilitating moisture penetration into the deeper soil layers. This promoted seedling establishment as indicated by the average of about 100 plants per 100 square feet on this seedbed. This is in contrast to the 30 plants or less established per 100 square feet on the other seedbeds. Pitting has been shown to be beneficial, but it is still inadequate in comparison with root plowing. Only in years of above normal summer rainfall will Lehmann lovegrass attain sufficient size to give economical forage production. The present indications are that Congress receives 3.8 inches of average summer precipitation. When seeding warm-season species, the requirement for precipitation is estimated to be between 4.5 to 5.5 inches of average summer precipitation.

Table 1. Average number of Lehmann lovegrass per 100 square feet on various seedbeds seeded at Congress, Arizona in 1966. Data taken November 1967.

Seedbed	Time and method of seeding				Average
	Broadcast		Drilled		
	March	June	March	June	
Root plowed	111	81	NT	NT	96
Chained-pitted	48	34	41	10	33
Cleared-pitted	26	21	34	16	24
Chained-disked	35	8	35	4	21
Cleared-disked	28	11	22	13	18
Average (Excluding root plowed)	34	37	33	11	

THE PIMA AREA

This section of the progress report covers the experimental range seeding studies at Pima for the years 1965, 1966, and 1967. Data were taken in late November 1967 on the seedings made in each of the above years. This data consists of forage yields of Lehmann lovegrass on various seedbeds and the number of plants per 100 square feet established in species adaptation trials. The seeding made in 1967 was evaluated only by the number of plants per 100 square feet.

The Pima Area is located in Sections 10, 15, 16, 21 and 22; T6S, R23E; Gila and Salt River Meridians. The location diagram depicting the placement of each year's seeding is shown in Figure 1.

Rainfall on the Pima Area was very sparse during the summer of 1967. From July 1 through September 30 there were 3.4 inches of rain, most of which occurred as small storms. On October 3 there fell 1.17 inches which is believed to be too late in the season to promote appreciable germination and seedling establishment. The distribution and amount of these rains is shown in Figure 2. These rains were probably minimal for the maintenance of established Lehmann lovegrass stands. Forage yields were consequently very low.

Forage Yields on 1965 and 1966 Seedings

Average forage yields in pounds per acre for various seedbeds sown in 1965 and 1966 are shown in Tables 2 and 3. These yields were determined from clipping 20, 1 by 5-foot quadrats on each seedbed within each of four replications.

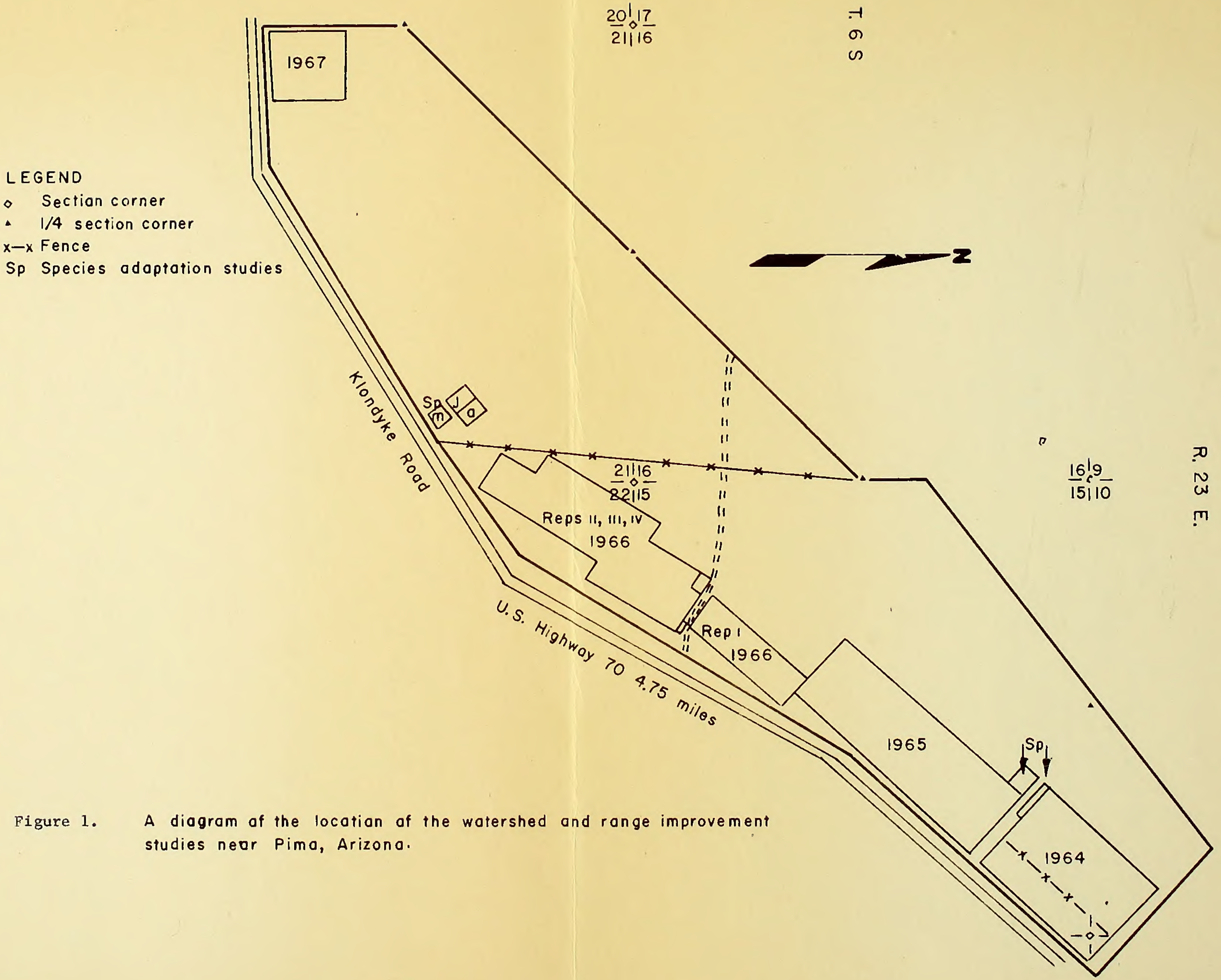

Figure 1. A diagram of the location of the watershed and range improvement studies near Pima, Arizona.

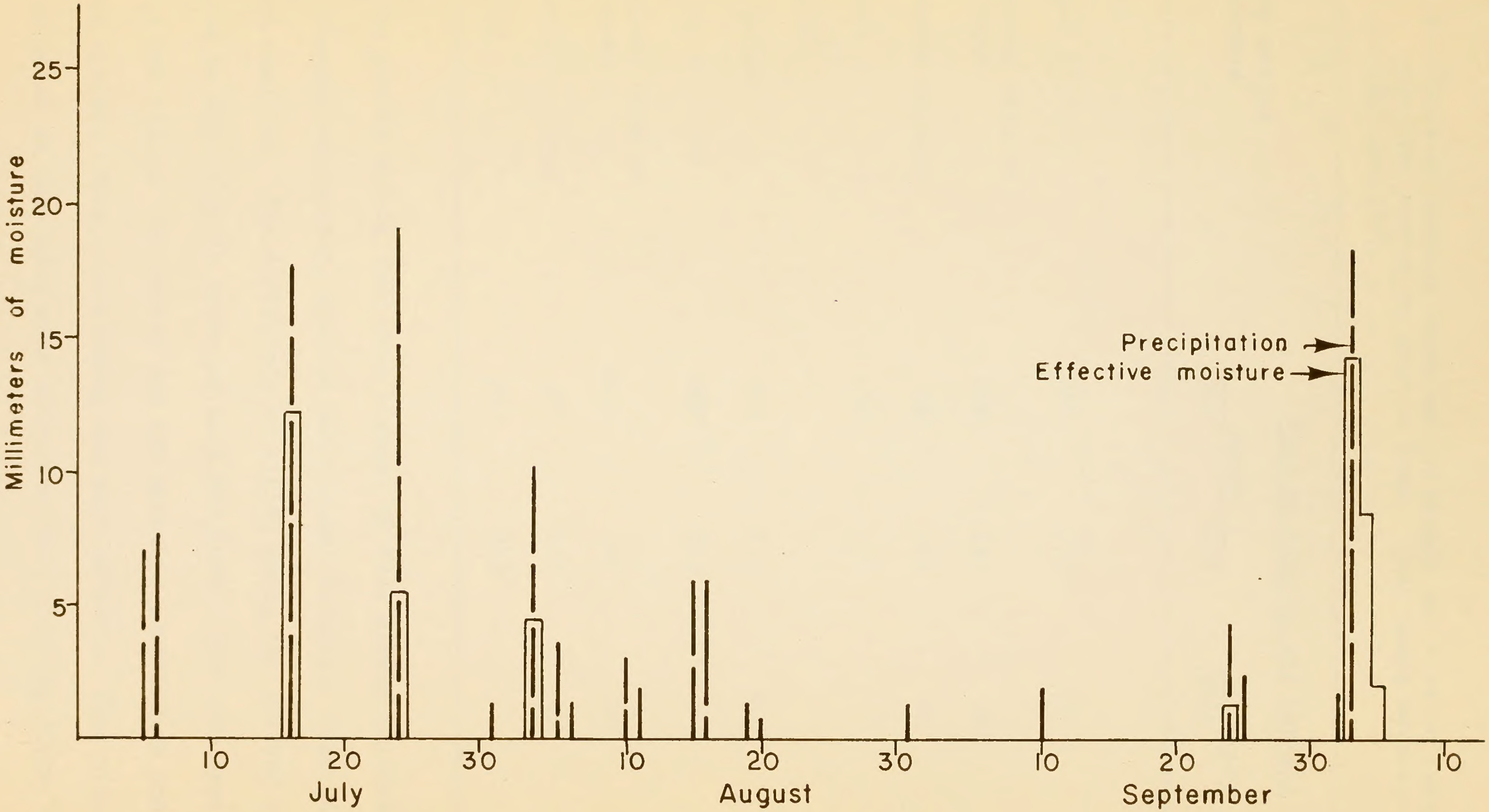

Figure 2. Precipitation and effective surface soil moisture (1-inch depth) at Pima during 1967.

Table 2. Yield of Lehmann lovegrass in pounds per acre on various seedbeds seeded in 1965 at Pima. Data taken November 1966 and 1967.

Seeding method and seedbed	Time of seeding and harvest			
	March		June	
	1966	1967	1966	1967
Drilled				
Chained & pitted	304	157	131	99
Bulldozer cleared & pitted	778	245	50	149
Bulldozer cleared	48	104	32	60
Chained	69	19	5	14
Broadcast				
Root plowed	340	412	575	245
Chained & pitted	880	183	1	89
Bulldozer cleared & pitted	1167	349	59	72
Bulldozer cleared	234	155	16	49
Chained	237	102	1	7

The yields during 1967 were highest on root plowed followed by bulldozer cleared and pitted, chained and pitted, bulldozer cleared, and chained seedbeds. The difference in yields among the seedbed preparations can best be explained in terms of soil moisture. The more deeply the seedbed was tilled, the better was the moisture penetration and the consequent yields. Thus, rootplowing was more effective than clearing and pitting which in turn were more effective than clearing alone. Of the

two clearing treatments, bulldozer clearing was more effective than chaining regardless of pitting. It is thought that bulldozer clearing removed much more of the competition from weedy annual grasses. The initial advantage due to seeding in March was still prominent in 1967 but not as pronounced as it was in 1965. The effects of root plowing were more permanent than those from pitting. The decrease in yield from 1966 to 1967 was least on the root plowed seedbeds.

Table 3. Yield of Lehmann lovegrass in pounds per acre on various seedbeds seeded in 1966 at Pima. Yields taken November 1967.

Seeding method and seedbed	Time of seeding		Average
	March 15	April 15	
Drilled			
Chained & pitted	33	16	25
Bulldozer cleared & pitted	124	86	105
Bulldozer cleared	36	11	24
Chained	0	6	3
Broadcast			
Root plowed	80	84	82
Chained & pitted	23	68	45
Bulldozer cleared & pitted	18	178	98
Bulldozer cleared	1	21	11
Chained	0	0	0

The yields from the 1966 seeding were also very low but the same trends indicated by the 1965 seedings were evident. The better seedbeds were root plowed, and bulldozer cleared and pitted.

An important aspect of evaluating these seedings would be the continuation of yield studies with respect to rainfall. This would include relating the various stand densities in terms of yield for different rainfall levels.

1967 Seeding

The objectives behind the 1967 seeding studies were: (1) to evaluate the difference in effects of deep soil tillage by root plowing and disk plowing,and (2) to differentiate the effects of soil disturbance from those of water-retaining or pitting practices. Root plowing leaves the coarser surface soil in place on top whereas disk plowing brings to the surface the finer clay subsoils. Disking with a tandem disk result in extensive surface soil disturbance while pitting with a disk pitter gives less soil disturbance but provides for surface water detention. The 1967 studies included the above methods of seedbed preparation. Brush was removed before the disking and pitting operations by means of bulldozer clearing.

The experiment was completely randomized with four replications. The plot size was 100 by 200 feet. Seedbed preparation and seeding was conducted in June. Lehmann lovegrass was broadcast and drilled on 90% of each plot. The remaining 10% (a 10-foot strip along the right-hand side of each plot) was seeded with an ARS experimental Boer lovegrass. A plot diagram of the experiment is shown in Figure 3.

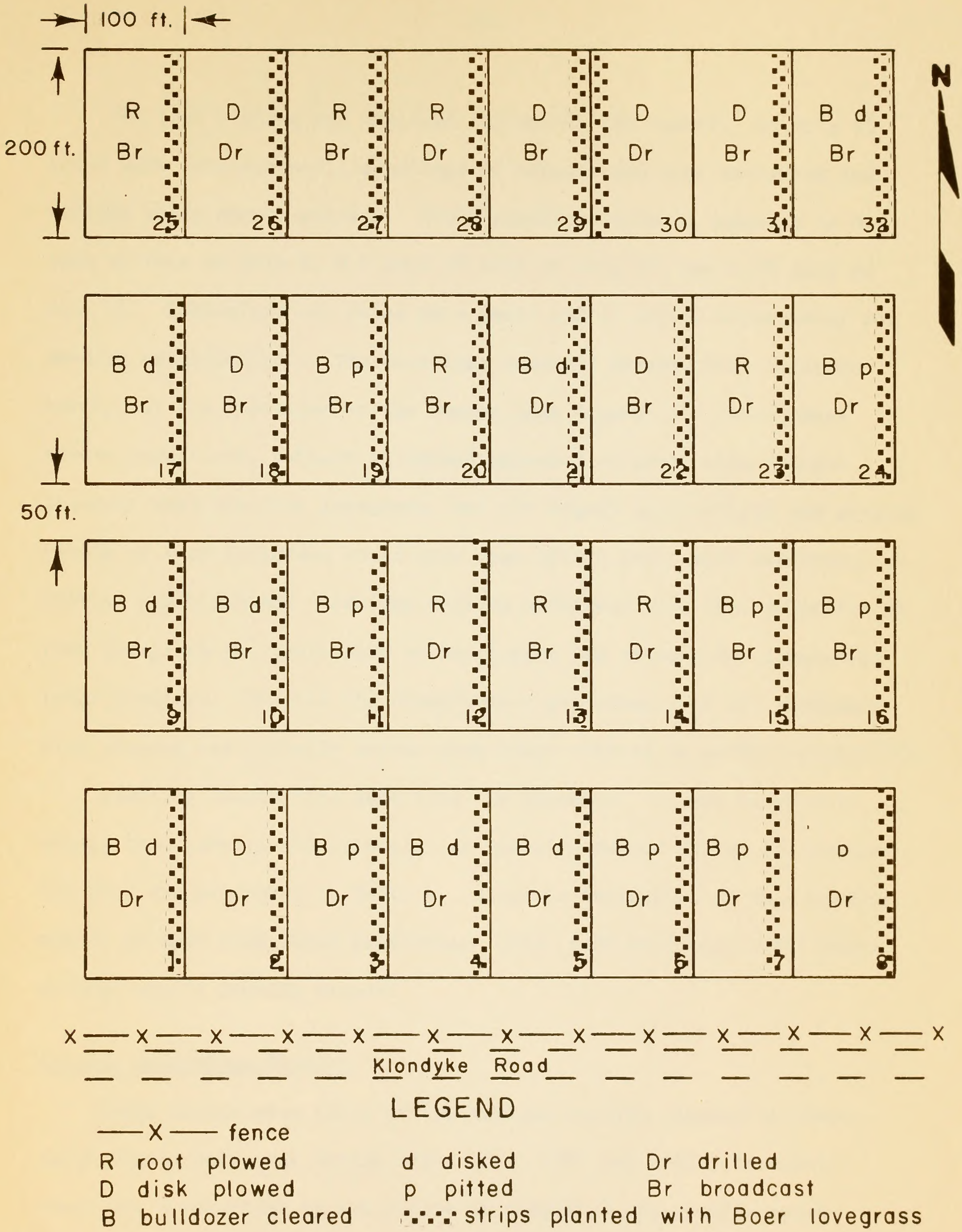

Figure 3. A plot diagram of seedbed preparations and seeding methods of Lehmann and Boer lovegrass during June 1967 near Pima, Arizona.

The 1967 seeding was observed throughout the summer. On July 25 there were numerous small seedlings of Lehmann and Boer lovegrass and various weedy annual grasses. These seedlings were in response to 0.3 inch of rain on July 6, 0.7 inch of rain on July 16, and 0.75 inch on July 24. Thereafter all rains were small and of little consequence for seeding establishment. The seedlings remained stressed for moisture throughout the remainder of the summer (see Figure 2). Under these severe conditions, Lehmann lovegrass appeared slightly more drought tolerant than the Boer lovegrass, but the higher palatability and greater yields of Boer lovegrass would more than offset this small difference in initial establishment. Studies will be continued with this selection of Boer lovegrass to obtain data to facilitate its release for commercial range seedings. Despite the overall poor performance of all seedbeds, disk plowing was markedly better than other methods of seedbed preparation.

Seedling counts were made late in December. It was noted that damage from rabbits was extensive as normally occurs during dry summers. The data are presented in Table 4. Adequate evaluation of this seeding cannot be made from these preliminary data, such evaluation will depend on next year's growing season.

Species Adaptation Studies

Plant counts were taken on the various species planted in adaptation trials each year during 1964, 1965, 1966 and 1967. Generally, there was a reduction in the number of plants of all species established. Still persisting in the 1964 nursery were blue grama, Boer lovegrass, Wilman lovegrass and turkestan bluestem. In the 1965 nursery, those species which had been well established still persisted

Table 4. The average number of Lehmann and Boer lovegrass per 100 square feet on various seedbeds near Pima planted June 1967.

Seedbed and seeding method	Species		
	Boer	Lehmann	Average
Drilled			
Root plowed	6	2	4
Disk plowed	15	19	17
Bulldozer cleared-disked	0	5	2.5
Bulldozer cleared-pitted	8	6	7
Broadcast			
Root plowed	6	5	6.5
Disk plowed	28	27	27.5
Bulldozer cleared-disked	3	2	2.5
Bulldozer cleared-pitted	16	30	23
Average	10	12	

even though a general decrease in stand has occurred. A comparison between the stands in 1966 and 1967 is presented in Table 5.

In 1966 the species were planted in March and June. Only the March seeding responded. There are no species established in the June seeding. Data for the March seeding are presented in Table 6, where the stands in 1966 and 1967 are compared.

During 1967 the species adaptation studies were extended to include more seeding dates. The objective was to gain more information on the effects of seeding various species at different dates. As the species

Table 5. The number of plants per 500 square feet in the species adaptation nursery planted at Pima, Arizona in 1965. Counted November 1966 and November 1967.

Plot				No. of Plants	
No.	Species	Common name and source		1966	1967
1	Spco	Spike dropseed	A-14544	0	2
2	Spcr	Sand dropseed	A-16352	3	2
3	Spai	Alkali sacaton	A-13156	3	1
4	Spus	Creeping dropseed		1	0
5	Erch	Boer lovegrass		36	27
6	Ersu	Wilman lovegrass	A-11965	3	3
7	Peci	Buffelgrass		1	0
8	Erin	Plains lovegrass	A-14242	2	1
9	Anis[1]	Turkestan bluestem	A-14207-60	15	5
10	rbi	Bicolor lovegrass	A-14152	1	0
11	Paan	Blue panicgrass	A-130	15	9
12	Paha	Hall's panicgrass	A-800	19	7
13	Paco	Pretoria panicgrass	A-12638	14	0
14	Paob	Vine mesquite	A-11711	2	1
15	Sema	Plains bristlegrass	A-14266	144	65
16	Trca*	California cottontop	A-8084	43	48
17	Bohi*	Hairy grama		361	135
18	Bocu*	Sideoats grama		646	390
19	Boer*	Black grama		65	90
20	Bogr	Blue grama	A-12424	570	255
21	Mupo*	Bush muhly	A-13273	9	0
22	Peci*[2]	Buffelgrass		46	1
23	Anis*[2]	Turkestan bluestem		232	210

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[1] Caryopses

[2] Trashy

* Broadcast seed

Table 6. The number of plants per 100 square feet planted in March, 1966 in the species adaptation nursery at Pima, Arizona.

Plot No.	Species	Common name and sources		No. of Plants 1966	1967
1	Erle	Lehmann lovegrass	A-68	108	36
2	Erle	Lehmann lovegrass	280-19(Apache)	80	34
3	Erch	Boer lovegrass	61-293-17(Cata.)	194	46
4	Erch	Boer lovegrass	A-84	44	26
5	Erch	Boer lovegrass	A-12752	68	32
6	Ersu	Wilman lovegrass	A-111965	96	28
7	Anis	Turkestan bluestem	A-14207	34	20
8	Spco	Spike dropseed	A-14544	14	14
9	Paan	Blue panicgrass	A-16851	96	36
10	Paan	Blue panicgrass	A-130	26	20
11	Paco	Pretoria panicgrass	A-12638	90	10
12	Paco	Pretoria panicgrass	A-12638-M63	54	16
13	Boer	Black grama	A-3780	0	26

seeding in 1966 indicated, there can be a very marked difference in response due to time of seeding. Due to the particularly dry growing season at Pima during 1967, there was a very poor response from all species at all seeding dates. The dates of seeding were March, June, and August. At each date the seedbed was prepared by disk plowing and the species were drilled. The plot size for each species was 10 by 200 feet.

Although no species emerged from the August seeding it was observed that this seedbed also was entirely free of weedy annual grasses. It is suggested that there may be a difference in the rate of establishment

between perennial and annual grasses. The date of planting might be adjusted to favor establishment of perennials over annual grasses. This factor will be observed during subsequent seedings.

The species planted at each date during 1967 and their respective plot numbers are listed in the following Table 7.

Table 7. The species adaptation nursery planted at Pima, Arizona on March 24, 1967; June 2, 1967 and August 24, 1967. Plants counted November 1967.

Plot No.	Species	Common name and source		No. of Plants/ 100 sq. ft.	
				March	June
1	Erle	Lehmann lovegrass	A-68	1.15	2.60
2	Erle	Lehmann lovegrass*	A-68	2.10	2.25
3	Erle	Lehmann lovegrass**	61-280-19	1.20	1.50
4	Erle	Lehmann lovegrass**	61-290-38	.90	.50
5	Erch	Boer lovegrass	A-84-62	.45	1.75
6	Erch	Boer lovegrass*	A-84-62	.85	.35
7	Erch	Boer lovegrass**(Catalina)	61-293-17	.75	2.93
8	Erch	Boer lovegrass* (Catalina)	61-293-17	2.10	2.05
9	Spcr	Sand dropseed	A-16352-62	.60	.30
10	Spco	Spike dropseed	A-14544-60	.45	.05
11	Spai	Alkali sacaton	A-920-63	.10	.05
12	Anis	Turkestan bluestem	A-14207-61	.15	.15
13	Paan	Blue panicgrass	A-16851-66(Afg)	1.90	1.05
14	Paan	Blue panicgrass	A-130-59	2.15	1.05
15	Paco	Pretoria panicgrass	A-12638	.15	.55
16	Ersu	Wilman lovegrass	A-11965	.45	.50
17	Bocu	Sideoats grama	Texas	.05	.05
18	Bocu	Sideoats grama*	Texas	0.0	0.0
19	Sema	Plains bristlegrass	A-9971-60	.10	.20
20	Atca	Four-wing saltbush	A-16831-63	0.0	0.0
21	Boer	Black grama[1]	Sonora-66	0.0	0.0

* The seed was treated with Ceresan M at rate of 4 oz. per 100 lbs. and with Capatan at rate of 4 lbs. per 100 lbs of seed.

[1] Broadcast, then chain dragged over the seedbed

** ARS Experimental Selections

No plants from August seeding in fall 1967

THE FREDONIA AREA

This section of the report covers the progress of the range seeding studies being conducted on the sagebrush rangelands near Fredonia. The several studies considered are:

(1) Forage yields of established seedings
(2) Yield increase due to globe mallow and sagebrush control in recent seedings.
(3) Progress of 1965 seeding
(4) Progress of 1966 seeding
(5) Summary of climatic conditions
(6) Nature of 1967 seeding studies
(7) Species adaptation studies

The geographic, edaphic, and vegetative characteristics of this area have been presented in previous progress reports.

Forage Yields from Established Seedings

During August 1967 forage yields were determined on seedings drilled in 1962, 1963 and 1964. Comparisons were made on the basis of weight of forage per acre and weight in grams per plant for three species. Only drilled seedings were sampled because stands from broadcast seedings were too sparse to be considered economically practical. The species were crested wheatgrass, Russian wildrye, and blue grama planted on plowed, brush chopped, and chopped and pitted seedbeds. The forage weights were obtained as described in the 1966 Annual Report covering the Fredonia area. These data are presented in Table 8.

Table 8. Forage yields in pounds per acre of three grass species drilled into various seedbeds during 1962, 1963, and 1964 near Fredonia, Arizona.

Time of Planting	Species[1]	Seedbed preparation			Average	
		Plowed	Brushchopped	Chopped & pitted	Weight/acre	Grams/plant
1962 Summer	Agcr	220	225	214	220	
Fall	Agcr	179	229	294	237	
	Elju	157	194	209	189	
1963 Summer	Bogr	176	436	208	273	2.58
Fall	Agcr	192	149	141	163	1.98
	Elju	91	51	72	74	1.38
1964 Summer	Agcr	275	176	268	242	4.05
Fall	Agcr	176	79	197	153	2.86
	Elju	57	23	107	65	2.05
Average yield		168	174	190		

[1] Agcr: Crested wheatgrass
Elju: Russian wildrye
Bogr: Blue grama

There was higher than normal spring moisture, and the wheat grasses were green and vigorous when observed during mid-June. There was very little growth on blue grama at this time. However, the yields from these seedings were surprisingly low. Crested wheatgrass averaged about 200 pounds of forage per acre during 1967, whereas it averaged over 500 pounds the preceding year. Russian wildrye similarly decreased in yield from 1966 to 1967 but blue grama maintained the same level of production.

Rainfall during the summer of 1967 was low, comprised mainly of several light showers. Moisture was sufficient for the maintenance of established grasses but insufficient for yield increases.

Control of Globe Mallow and Sagebrush in New Seeding

Studies were started in 1966 on the effects of removing globe mallow from certain seedings by the use of herbicidal sprays. These sprays were applied May 1966 to crested wheatgrass and Russian wildrye drilled in 1963 and 1964 on certain seedbeds. The yield data taken during 1966 on sprayed and non-sprayed plots showed no difference due to spraying. Yield data were again taken in August 1967 and they are presented in Table 9. When observed in June and September of 1967 there was little or no visual differences among most of the sprayed and non-sprayed plots. The best difference is depicted in Figure 4. However, there was a marked improvement in forage yields on the sprayed plots during 1967. This increase in forage was due to an estimated 25% reduction in small sagebrush plants and from 50 to 90% reduction in globe mallow. It is suggested that seedbed preparation in this range area be performed with the objective of very thorough brush eradication. Otherwise brush invasion will negate all values from seeding.

Table 9. The effect of globe mallow control on the yield of crested wheatgrass and Russian wildrye seeded near Fredonia, Arizona.

Year of planting and seedbed	Species	Non-sprayed		Sprayed		Percentage increase
		wt/acre	grams/plant	wt/acre	grams/plant	
1963 - Fall						
Plowed	Agcr	192	2.20	337	5.09	76
	Elju	91	1.80	297	5.43	226
Brushchopped	Agcr	149	2.04	212	2.86	42
	Elju	51	.98	124	2.30	143
Chopped & pitted	Agcr	141	1.70	193	4.27	37
	Elju	72	1.40	215	4.76	199
1964 - Summer						
Plowed	Agcr	275	4.85	415	6.36	51
Brushchopped	Agcr	176	1.83	317	3.60	80
Chopped & pitted	Agcr	268	5.47	427	6.84	59

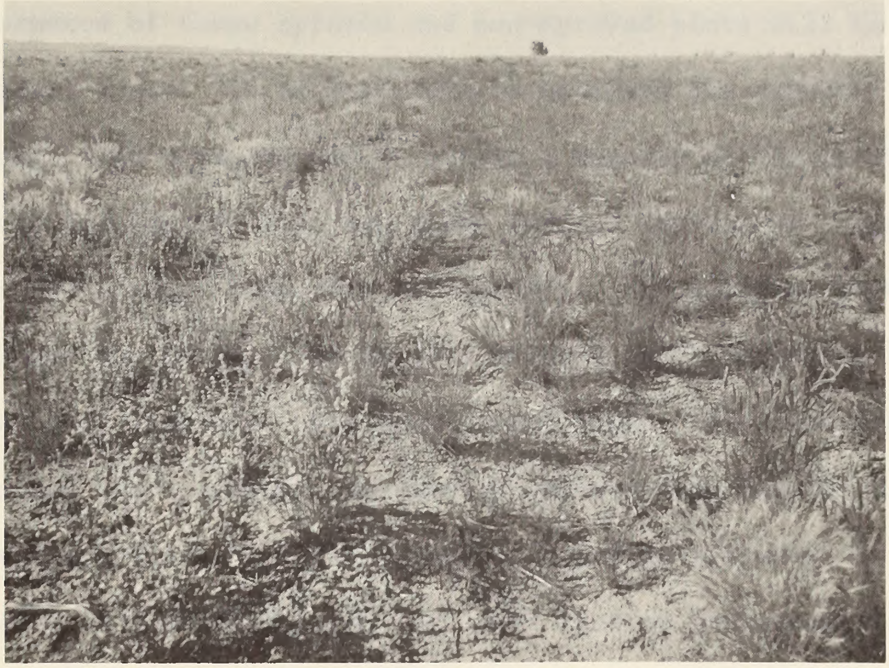

Figure 4. Globe mallow control in crested wheatgrass. right half sprayed with 2,4-D, May 1966. Photographed June 1967.

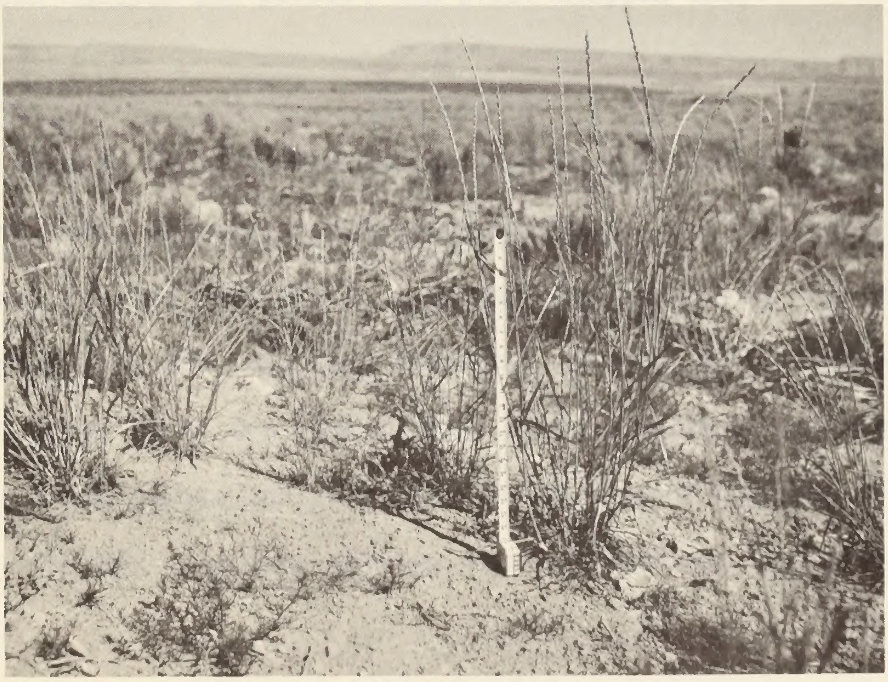

Figure 5. Luna pubescent wheatgrass seeded October 1965. Photographed June 1967.

The performance of these sprayed and non-sprayed plots will be monitored over several years. It is desirable to estimate the economic advantages, if any, from spraying and to obtain a measure of the persistance of certain range grasses in this area under various degrees of competition. Certain trends are evident from this year's data. The greatest percentage increase in forage was produced by Russian wildrye which indicates that its growth was being inhibited more from competition. This indicates that crested wheatgrass has a greater competitive ability than Russian wildrye. Even though Russian wildrye has the highest percentage increase, it had lower net total pounds of forage per acre than crested wheatgrass.

Comparison of the values of weight/plant in grams indicates that the more intensively tilled seedbeds have the greater potential for yield. In order of decreasing plant size and vigor, the seedbeds would be listed as plowed, brush chopped and pitted, and brush chopped only.

1965 Seeding

Detailed studies were started during 1965 on the time and method of seeding several range grasses on different seedbeds. The species seeded during July were crested wheatgrass, siberian wheatgrass, Russian wildrye, blue grama, spike dropseed, and sand dropseed. During October pubescent wheatgrass was substituted for blue grama. Seeding methods were broadcasting and drilling before and after the seedbeds were prepared. The seedbeds were prepared by either plowing with a Brushland Plow or by brushchopping.

Plant counts were taken during August 1967 on both summer and fall seedings, and yield data were taken on the fall seeding. The summer seeding has not responded sufficiently well to make yield data meaningful.

Almost no plants of blue grama, spike dropseed, or sand dropseed were established on either seeding and no data were available. For the other species the data are summarized in Tables 10 and 11 for the summer and fall seedings, respectively.

The 1965 summer seeding had a poor emergence and has not improved during the last two growing seasons. The plants on the plowed seedbeds are slightly more vigorous than those on the brushchopped. Both types of seedbeds have about the same number of plants. However, there may be one important indication from this seeding. Brushchopping after seeding, particularly with broadcasting, may be undesirable. While it provides some additional seed coverage, this coverage is too shallow. The seeding would therefore respond to the lighter rains but, unless followed by additional rain, the seedlings could not become established. In other words, it might be better to sow as deeply as practical. The more deeply placed seeds would not germinate as readily until sufficient moisture had accumulated to also bring about establishment.

The fall seeding of 1965 responded well, especially on the plowed seedbeds. Due to the more uniform moisture conditions of winter, brushchopping after seeding was not as detrimental as it was in the summer seeding. Drilling on plowed ground promoted markedly better stands than any other method of seeding. While the number of plants from the other seeding methods were comparable, the plants on the plowed seedbeds, whether drilled or broadcast, were much more vigorous. The most vigorous plants were those on the seedbeds plowed after broadcasting. It is believed these plants developed from the more deeply-placed seeds (Figures 5, 6, and 7). The weight in grams per plant, presented in Table 11 illustrates

Table 10. The average number of plants per 100 square feet on various seedbeds for several seeding methods and species. Seeded July 1965 near Fredonia, Arizona, and counted August 1967.

Method of seeding and seedbed	Species and year of count							
	Crested wheatgrass		Siberian wheatgrass		Russian wildrye		Average	
	66	67	66	67	66	67	66	67
Drilled								
Plowed before seeding	26	24	31	36	7	7	21	22
Brushchopped before seeding	37	35	28	25	12	4	25	21
Brushchopped after seeding	12	25	18	21	4	3	11	16
Broadcast								
Plowed before seeding	27	41	47	46	13	7	29	31
Plowed after seeding	12	15	12	12	7	8	10	11
Brushchopped before seeding	42	20	70	38	12	4	41	21
Brushchopped after seeding	12	12	17	9	2	3	10	8
Species average	24	25	30	26	9	5		

Table 11. Forage weight in pounds per acre for various seedbeds for several seeding methods and species planted October 1965 near Fredonia, Arizona. Counted August 1967.

Method of seeding and seedbed	Species				Averages		
	Pubescent wheatgrass	Crested wheatgrass	Siberian wheatgrass	Russian wildrye	Weight per acre	Number 100 sq.ft.	Grams/ plant
Drilled							
Plowed before seeding	199	288	235	91	203	60	3.40
Brushchopped before seeding	82	63	54	0	50	39	1.36
Brushchopped after seeding	86	49	39	4	45	21	2.30
Broadcast							
Plowed before seeding	197	176	117	71	140	24	6.13
Plowed after seeding	275	214	173	61	181	30	6.16
Brushchopped before seeding	41	19	7	0	17	3	5.31
Brushchopped after seeding	71	47	57	0	44	21	2.24
Averages: Pounds/acre	137	124	97	32			
Plants/100 sq.ft.	38	38	29	11			
Grams/plant	3.72	3.41	3.42	3.20			

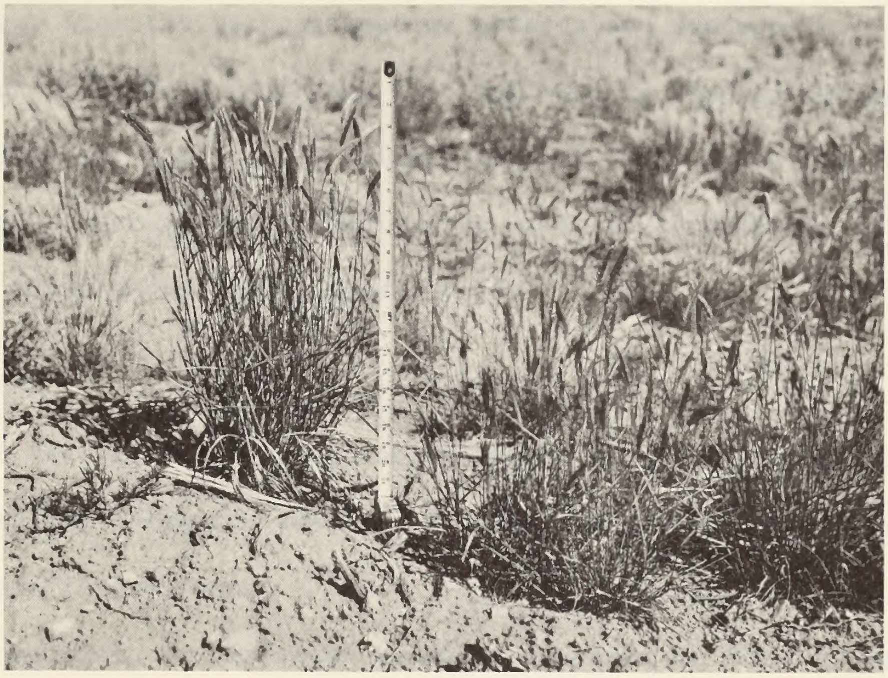

Figure 6. Crested wheatgrass (Nordan) seeded October 1965. Photographed June 1967.

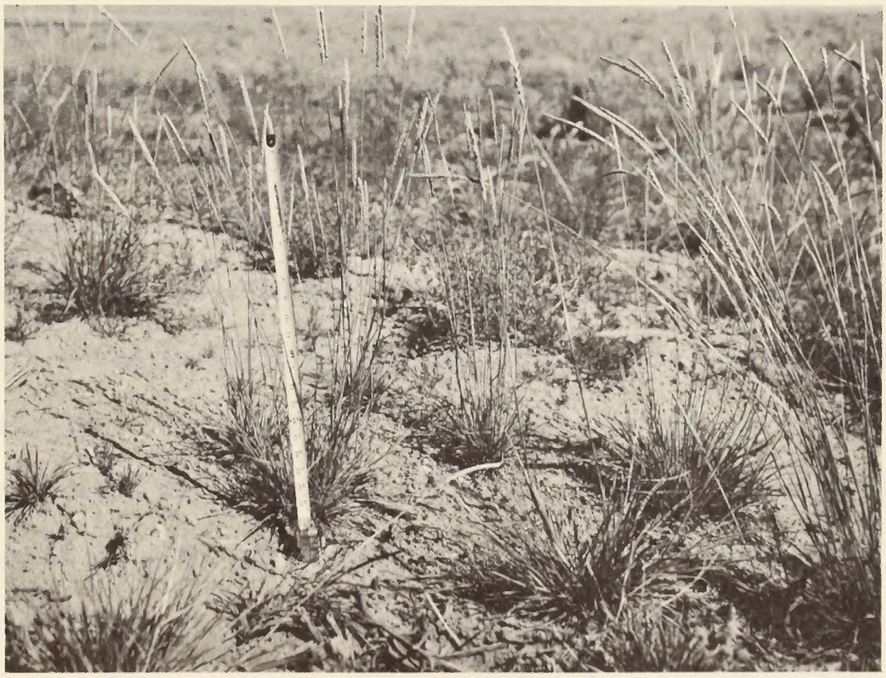

Figure 7. Russian wildrye seeded October 1965. Photographed June 1967.

the plant vigor from the various seeding methods and seedbeds.

Pubescent wheatgrass responded best followed by crested wheatgrass, Siberian wheatgrass, and Russian wildrye in that order. The vigor and larger size of pubescent wheatgrass can be noted in comparisons of weight in grams per plant among the various species.

1966 Seeding

The 1966 seeding was a continuation of the studies started in 1965 concerned with the extensive testing of promising species under various factors. These factors were:

1. A comparison of different seedbeds prepared by brush chopping, disk plowing, burning, and herbicide spraying;
2. Six species consisting of crested wheatgrass, siberian wheatgrass, pubescent wheatgrass, Russian wildrye, spike dropseed, and sand dropseed;
3. A comparison of seeding methods consisting of broadcasting and drilling before and after seedbeds were prepared; and
4. A comparison of time of seeding in July with October.

Plant counts were made on the 1966 seeding during August, 1967 and the results are presented in Table 12 for the July seeding and in Table 13 for the October seeding. Pending final results based on forage yields, the following conclusions are indicated. The fall seedings responded better than summer seedings with the possible exception of the drop seeds. The summer seeding emerged on the same winter moisture that brought up the fall seeding. Drilling was more effective than broadcasting with the larger-seeded species. Again the dropseeds might be an exception because they can be seeded too deeply by drilling. Emergence and establishment is

Table 12. The average number of plants per 100 square feet in the 1966 summer experimental seedings near Fredonia, Arizona.

Methods of seeding and seedbed	Species seeded						Average
	Agcr	Agtr	Agsi	Elju	Spco	Spcr	
Drilled							
Plowed before seeding	20	39	6	3	11	5	14
Brushchopped before seeding	5	21	8	2	3	2	7
Brushchopped after seeding	17	62	5	2	4	3	15
Herbicide sprayed	11	26	8	6	13	5	12
Burned	14	33	7	6	9	5	12
Broadcast							
Plowed before seeding	5	23	9	2	13	10	10
Plowed after seeding	9	13	6	3	4	4	7
Brushchopped before seeding	8	17	2	1	4	2	6
Brushchopped after seeding	10	19	9	3	4	5	8
Herbicide sprayed	1	13	5	3	4	1	4
Burned	9	29	4	3	5	5	9
Average	10	27	7	3	7	4	

Table 13. The average number of plants per 100 square feet in the 1966 fall experimental seedings near Fredonia, Arizona.

Methods of seeding and seedbed	Species seeded						Average
	Agcr	Agtr	Agsi	Elju	Spco	Spcr	
Drilled							
Plowed before seeding	50	106	37	22	7	1	37
Brushchopped before seeding	43	59	13	13	2	2	22
Brushchopped after seeding	44	78	36	19	8	1	31
Herbicide sprayed	79	60	38	20	5	1	33
Burned	49	71	53	25	2	1	33
Broadcast							
Plowed before seeding	96	74	36	23	4	5	39
Plowed after seeding	37	22	21	11	1	4	16
Brushchopped before seeding	5	9	2	1	14	5	6
Brushchopped after seeding	11	42	14	5	0	0	12
Herbicide sprayed	0	0	1	0	0	1	1
Burned	3	9	6	8	14	9	8
Average	39	50	24	14	5	3	

generally better on the more extensively prepared seedbeds such as from plowing. Three factors should be considered with respect to seedbed preparation by plowing. These are: (1) possible increased water penetration, (2) more adequate seed coverage, and (3) more adequate removal of competitive sagebrush. Certain unfavorable aspects may also be promoted by plowing. Occasionally, plowing will promote the response of Russian thistle or globe mallow which offer excessive competition to seedling grasses. Where the sagebrush was adequately controlled by burning or herbicide spraying, satisfactory stands might also be established by drilling. More conclusive results will not be available until yield data have been collected.

It was also observed that the most vigorous grass plants were on the plowed seedbeds. This has been previously illustrated by the weight-per-plant data presented for earlier seedlings.

Pubescent wheatgrass has consistently produced seedlings of higher vigor, greater number of seedlings, and the higher yields. Crested wheatgrass would be ranked next followed by siberian wheatgrass. In comparison with this response of these three wheatgrasses, Russian wildrye should be considered borderline for seeding on the Arizona Strip.

Spike dropseed is more responsive than sand dropseed. It is suspected, however, that its response might be critically dependent on the nature of the growing season. It was noted from observations that spike dropseed responded very well during the summer of 1967. Some plants were larger and had considerably greener forage than any of the wheatgrasses during this year. This development occurred despite low rainfall. It is believed that methods for the consistant, dependable establishment of this grass should be studied. Once established, it appears that spike

dropseed might be as drought tolerant and more persistant than crested wheatgrass in this range. However, current methods of establishing spike dropseed have not been dependable.

Summary of climatic conditions

A survey of the weather conditions from January 1966 through 1967 helps to interpret the results from the various seedings. The response from the 1966 fall seeding was much better than that from the 1965 seeding, despite better winter moisture for the 1965 seeding. A comparison of the moisture and temperature conditions following each seeding is depicted in Figure 8. The period of January 15 through March 5 had an average temperature below freezing during 1966. The same period in 1967 averaged up to 10 degrees above freezing which is thought to have been a major factor in the good response of the 1966 fall seeding.

Also depicted in Figure 8 is the long-term temperature pattern for the period of January through May. This long-term pattern indicates that 1966 was considerably colder than normal while 1967 was warmer than normal during the late winter and spring months.

For the current 1967 season, from July through September, there were numerous small rains, but few were large enough to result in effective moisture. These rains might have been effective in preventing loss of established plants but no additional increase in forage was obtained. It was judged, visually, that very little increase in plant size occurred from mid-June through September. This is further illustrated by the low forage yields during 1967.

1967

Experimental range seedings on the Arizona Strip during 1967 consisted

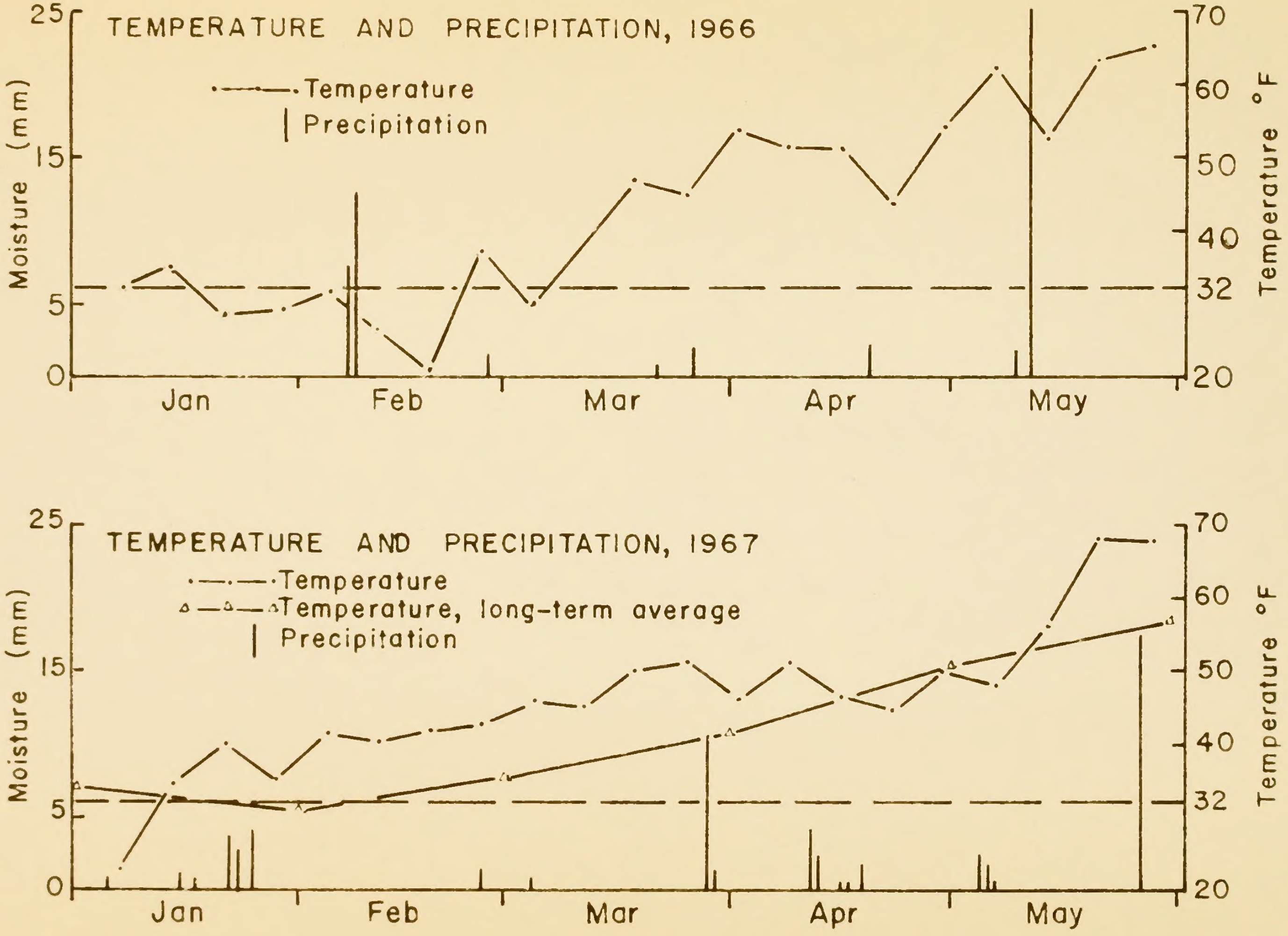

Figure 8. Temperature and precipitation comparisons for 1966 and 1967 near Fredonia, Arizona.

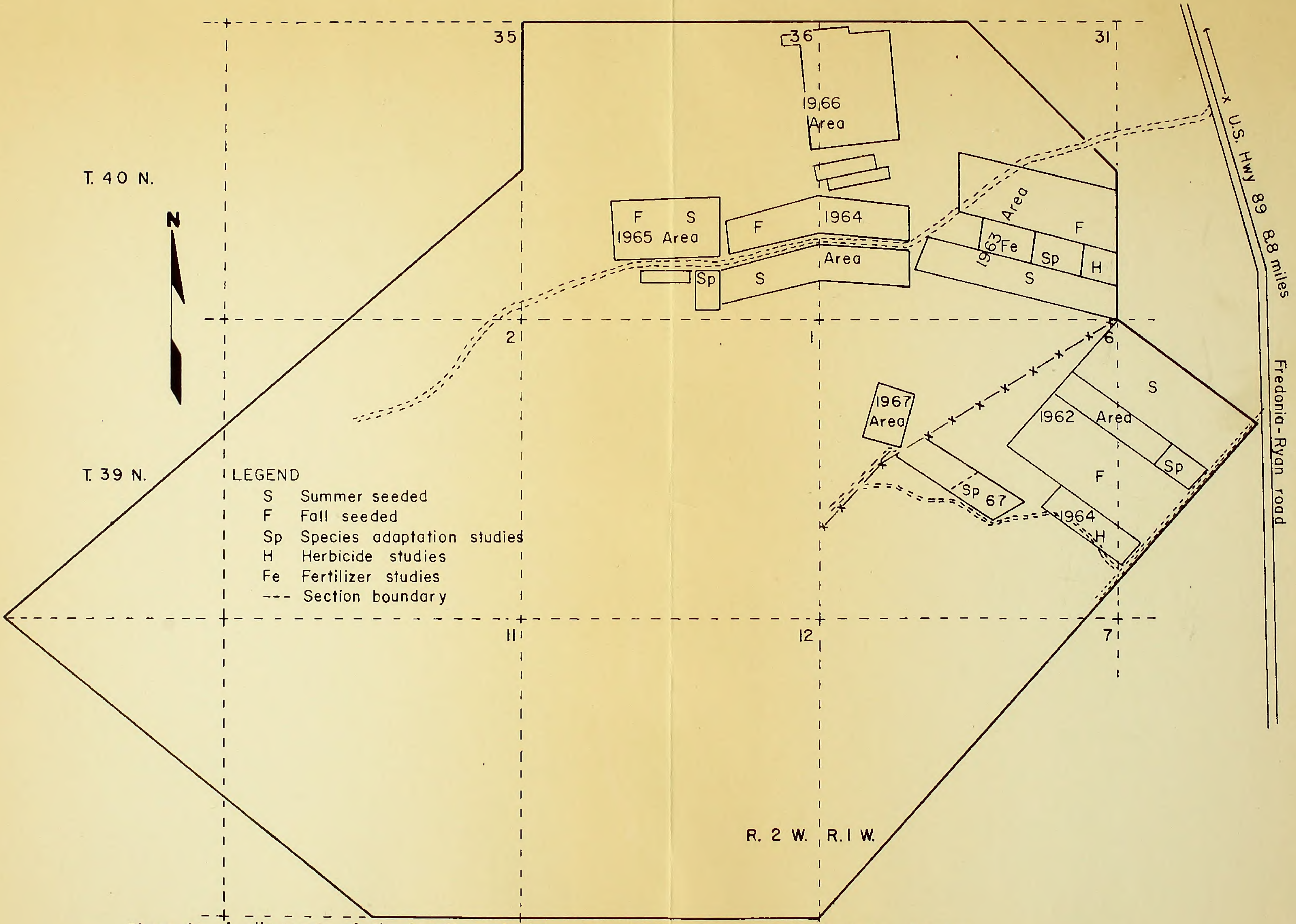

Figure 9. A diagram of the location of the range seeding studies near Fredonia, Arizona.

of two studies:

(1) the rate and depth of seeding of adapted grass species

(2) species adaptation with respect to establishment, yield and utilization

These studies are located northwest of the 1962 seeding as illustrated in Figure 9. All seedbeds were prepared by plowing with a tandem disk. The species adaptation plots were fenced with rabbit-proof fence. Both studies were established in mid-October.

It has been observed in previous seedings that the plants from the plowed-after-broadcasting seeding procedure had very good vigor. While many of the seeds would be buried too deeply by such procedures, it appears that greater planting depths promote a better seed-soil-moisture relationship. It has also been observed that better stands of grass are established outside of the experimental plots on areas used for turning the Rangeland Drill. These areas received higher than normal seeding rates.

All micro-environmental niches of the seedbed suitable for germination and seedling growth should be planted. The above two observations indicate that the more favorable niches are not being utilized, and all niches are not being planted. A depth and rate of seeding experiment was established for crested wheatgrass Agropyron desertorum, pubescent wheatgrass A. tricophorum, and Russian wildrye Elymus junceus.

Each species was seeded at the following rates of 0.5, 1.0, and 1.5 million seeds per acre. The rate of one million seeds was considered as a normal seeding rate. For each species this normal rate in pounds per acre of 100% PLS is as follows:

(1) Crested wheatgrass, 180,000 seeds/lb, 5.56 lb/acre

(2) Pubescent wheatgrass, 100,000 seed/lb, 10.0 lb/acre

(3) Russian wildrye, 170,000 seeds/lb, 5.88 lb/acre

Each species was seeded at two depths. The standard depth was approximately 3/4 inch obtained from the use of the one-inch depth bands on the furrow openers. Deep planting at about the 1 1/2 inch depth was obtained by removal of depth bands and by the addition of a 25-pound weight to each furrow opener.

The experiment employed a completely randomized, split-plot design. The split was according to species to facilitate planting procedures with all other factors assigned at random. There were four replications. The plot size was 35 by 200 feet. The plot diagram is presented in Figure 10.

Data from this study will consist of time of emergence, number of plants per 100 square feet, and yield per acre when the planting becomes established. If adequate moisture is available, these data will be available beginning June 1968.

Species Adaptation Studies

The species adaptation studies for 1967 were expanded extensively from previous studies. The primary objective was to determine those species that can be established and utilized under normal climatic conditions on the Arizona Strip. A uniform seeding rate was used for all species were possible to facilitate evaluating seedling response and yield evaluations. Those species planted in plots 1 through 60, 66, and 67 were seeded at the rate of one million seeds per acre excepting four-wing saltbush, which was seeded at a lower rate (Table 14). Three other important browse species, winter fat, bitterbrush, and cliffrose

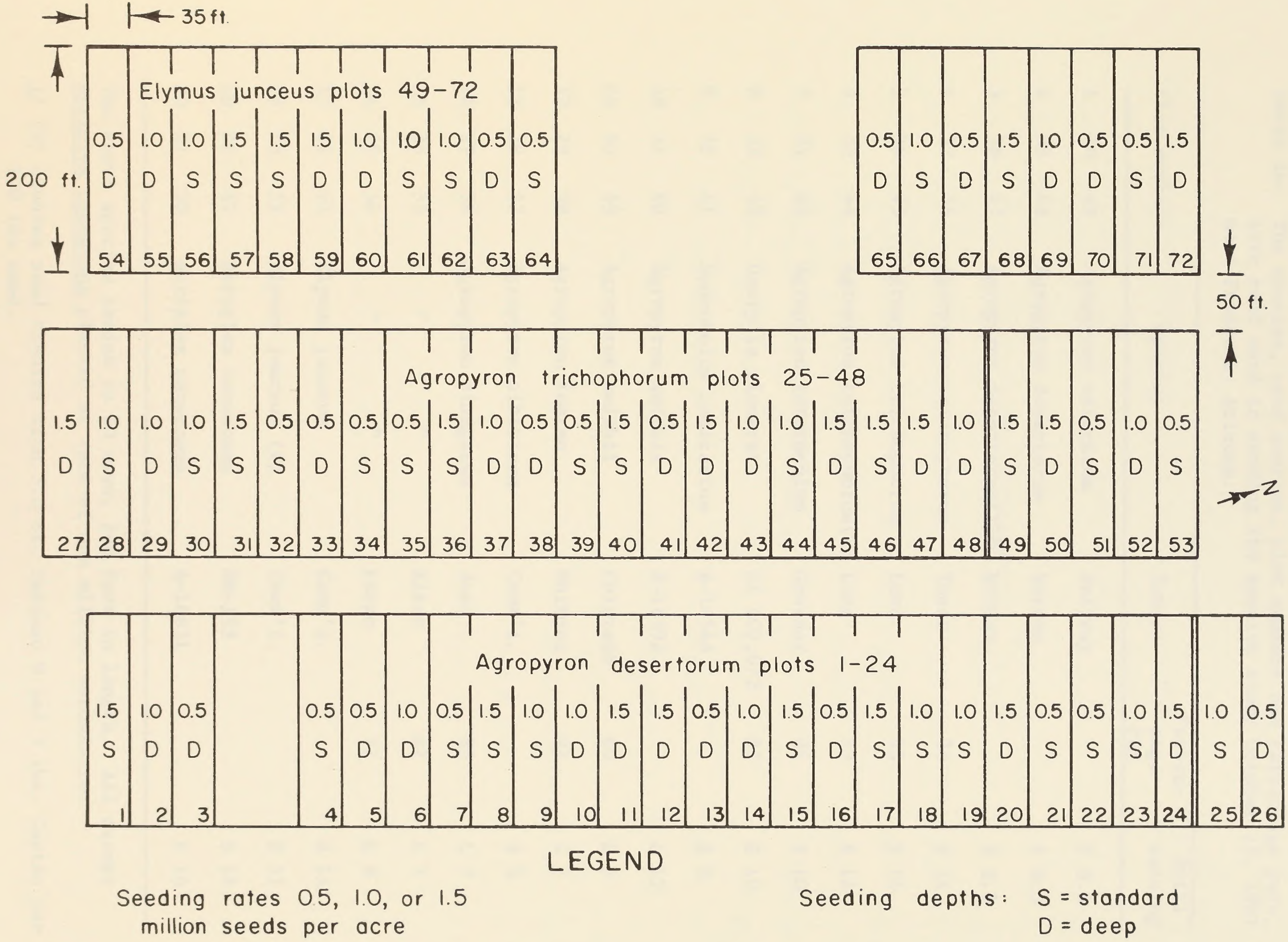

Figure 10. A plot diagram for rate and depth of seeding of three species planted October 15, 1967 near Fredonia, Arizona.

Table 14. The species, seed sources, plot numbers and percentage pure, live seed used in seeding the species study October 15, 1967 near Fredonia, Arizona.

Plot numbers			Species	Source	Percentage PLS	Drill setting
1	40	49	Agropyron cristatum	Fairway		S 5.5
2	39	48	Agropyron desertorum	Nordan		S 5.5
3	38	47	Agropyron desertorum(T)[1]	Nordan		S 5.5
4	37	46	Agropyron trichophorum	Topar	86	S 14
5	36	45	Agropyron trichophorum	Luna	93	S 14
6	35	44	Agropyron trichophorum(T)	Luna	93	S 14
7	34	43	Agropyron intermedium	Greenar	84	S 10
8	33	42	Dactylis glomerata	PI 109,072	85	S 10
9	32	41	Sporobolus contractus	A-14544		2 S
10	31	60	Agropyron smithii	A-16592		L 12
11	30	59	Agropyron smithii	Colorado	60	L 9
12	29	58	Agropyron inerme	Whitmar	92	L 7
13	28	57	Agropyron sibiricum	Comm'l.		S 5
14	27	56	Agropyron elongatum	Jose	86	L 7
15	26	55	" "	Alkar	82	L 7
16	25	54	" "	Largo	77	L 8
17	24	53	Elymus junceus	Comm'l.		S 11
18	23	52	Elymus junceus (T)	Comm'l.		S 11
19	22	51	Atriplex canescens	NM-155		S 14
20	21	50	Atriplex canescens	A-16831		S 14

The above species seeded in 20 rows, 200 feet in length. All except Atriplex canescens planted at rate of one million seeds/acre.

[1] (T) denotes seed treated with 3.0 oz. Ceresan M and 3 lbs. Captan per 100 lbs seed.

(Species list for 1967, Fredonia, continued)

Plot numbers	Species	Source	Percent PLS	Drill setting
61	Eurotia lanata 2 rows, 130 feet long, hand planted	GBES[2/] U10		
62	Purshia tridentata 6 rows	GBES U31		S 12
63	Hilaria jamesii 4 rows, 135 feet long, hand planted	Mt. Trumble, Arizona		
64	Purshia tridentata 6 rows	GBES U 31		S 12
65	Cowania stansburiana 25 rows	GBES U20		S 8
66	Agropyron trachycaulum 20 rows	Primar	98	S 12
67	Agropyron dasystachyum 20 rows	P-14943	65	L 25
68	Agropyron cristatum (rhizomatus) 10 rows	GBES U5 P.I. 109,012		S 5
69	Dactylis glomerata 15 rows	GBES P.I. 109,072		S 8
70	Oryzopsis hymenoides 15 rows	P-2575	30	S 12
71	Orhy 10 rows	A-16503	7	S 14
72	Orhy 5 rows	GBES U7		S 8
73	Orhy 5 rows	GBES U11 Cracked seed		S 14
74	Orhy 20 rows	GBES U15-66		S 8
75	Orhy 5 rows	GBES U10 Old seed		S 8

[2/] GBES: Great Basin Experiment Station at Ephraim, Utah; U.S.F.S.

were included in this study. Additional browse species will be included in future studies as seed becomes available.

Also incorporated in the species study were the effects of protection by an insecticide and a fungicide. Both fungicide-treated and non-treated seeds of crested wheatgrass, pubescent wheatgrass, and Russian wildrye were planted. The fungicide treatment consisted of 3.0 oz. of Ceresan M and 3.0 lbs of Captan per 100 lbs of seed. The insecticide was granular Dieldrin broadcast as a strip across all plots at the rate of 10 lbs of 2.5% material per acre. This strip was 50 feet wide across the northern end of all plots.

The plot size was 25 by 200 feet except for certain species plots where insufficient seed was available. Where seed was available three replications were planted.

Table 14 is a listing of all species, replicated and non-replicated, treated and non-treated, and number of rows seeded. Figure 11 is a plot diagram showing planting arrangement and manner of treatment with Dieldrin.

Evaluations were made on the species established in previous years. For the species established in 1963, forage yields were determined. These yields are presented in the following Table 15. Caution should be used in interpreting and applying the results from these yield data for use on the Arizona Strip. These species were established during a good rainfall year, therefore, the listing in Table 15 does not accurately indicate those species which can be used in a consistently successful seeding program. However, this list does indicate the potential of various species if they can be established by improved methods of seeding. The data forth-

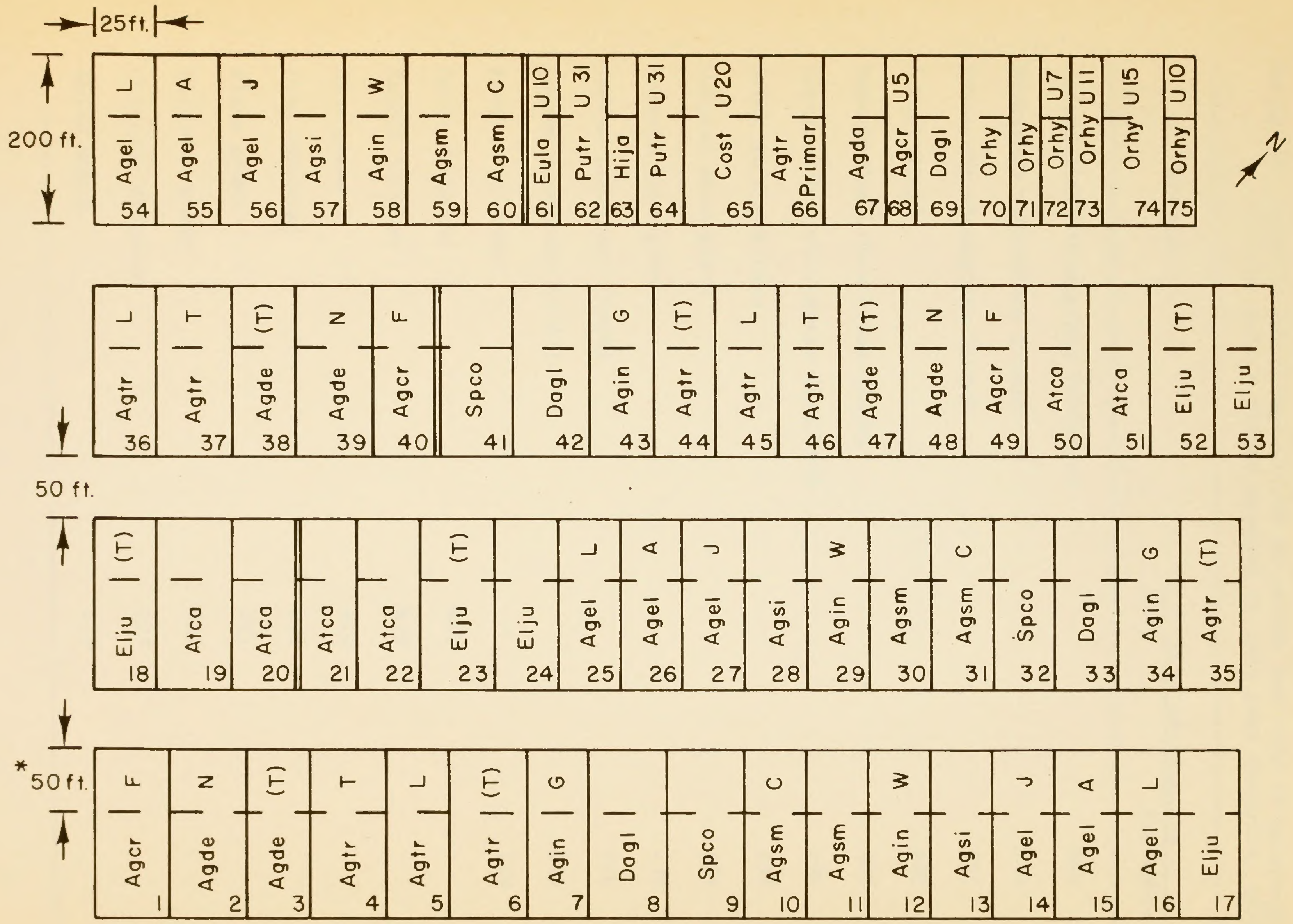

Figure 11. A plot diagram for the species study planted October 15, 1967 near Fredonia, Arizona. The (T) indicates fungicide-treated seeds and the * indicates a dieldrin-treated strip.

Table 15. Comparative forage yields in pounds per acre of selected species drilled into a plowed seedbed in 1963 near Fredonia, Arizona.

Species	Time of planting	
	July	September
Intermediate wheatgrass (Greenar)		909
Pubescent wheatgrass (Topar)		906
Pubescent wheatgrass (Luna)		751
Squirreltail		728
Intermediate wheatgrass (Amur)		702
Intermediate wheatgrass (A-12496)		700
Siberian wheatgrass		637
Crested wheatgrass		374
Western wheatgrass		234
Indian ricegrass (4406)		220
Indian ricegrass (3763)		146
Russian wildrye		119
Spike dropseed	849	
Alkali sacaton	675	
Blue grama	620	
Sand dropseed	612	
Black grama	441	
Sideoats grama	335	
Creeping dropseed	277	
Spike muhly	155	

coming from the 1967 species trials will supplement this preliminary information.

Evaluations of the species trials established in 1964, 1965 and 1966 consist of the number of plants per 100 square feet. These data are presented in Tables 16, 17 and 18. These data indicate that only certain wheatgrasses can be recommended for seeding on the Arizona Strip. These are pubescent, crested and siberian wheatgrass. Other promising species at this time are Greenar intermediate wheatgrass, Whitmar beardless wheatgrass, and possibly one or more selections of Indian ricegrass. These are the main species being extensively tested in the 1967 trials with respect to yield and ability to withstand utilization. Unless better stands of Russian wildrye can be obtained through variations in rate and depth of seeding, it should not be seeded in this rainfall zone on the Strip.

Table 16. The number of plants per 100 square feet in a species adaptation nursery planted in July and September, 1964 near Fredonia, Arizona.

Plot	Species		Date Counted		
No.	(Seeded early July)	Source	9/3/65	6/29/66	7/15/67
1	*Agropyron cristatum*	(Comm'l)	87.5	105	67
2	*Agropyron tricophorum*	(Luna)	48.5	66	64
3	*Bouteloua gracilis*	(Stock)	33.0	18	12
4	*B. gracilis*	A-12424	7.0	20	5
5	*B. curtipendula*	A-3603	42.5	31	34
6	*B. eriopoda*	A-3730	8.0	0	0
7	*Eragrostis lehmanniana*	A-14107	0.5	0	0
8	*E. bicolor*	A-1415	0.5	0	0
9	*E. curvula*	(Comm'l)	1.5	0	0
10	*Muhlenbergia porteri*	A-13273	1.0	0	0
11	*M. wrightii*	A-8604	0.5	1	0
12	*Sanquisorba major*	A-14173	3.5	0	0
13	*Tetrachne dregei*	A-14408	0	0	0
14	*Digitaria eriantha*	A-12616	0	0	0
15	*Leptochloa dubia*	A-12254	0	0	0
16	*Oryzopsis hymenoides*	A-12242	5.5	2	0
17	" "	A-14719	1.5	5	2
18	" "	A-16503	2.5	3	0
19	*Sporobolus airoides*	A-13156	3.5	4	0
20	*S. contractus*	A-14544	7.5	10	0
21	*S. cryptandrus*	A-16352	70.0	2	5
22	*S. usitatus*	A-14399	2.5	8	3
23	*S. flexuosus*	A-10117	1.0	2	0
24	*Andropogon ischaemum*	A-14207	36.5	5	0
25	*Atriplex canescens*	A-16652	7.5	7	9
26	*Sanquisorba minor*	A-14173	0.5	2	0

Table 16 (Continued)

Plot No.	Species (Seeded early September)	Source	Date Counted 9/3/65	6/29/66	9/15/67
1	Agropyron tricophorum	(Topar)	15.5	23	11
2	A. cristatum	(Comm'1)	35.5	60	52
3	Kangaroo Valley rye		1	3	2
4	A. intermedium	A-12496	37	69	27
5	A. intermedium	(Amur)	31	46	53
6	" "	(Greenar)	31	51	33
7	Eragrostis lehmanniana	A-14107	0	0	0
8	Agropyron tricophorm	(Luna)	56	89	103
9	A. sibericum	P-27	42	45	32
10	A. inerme	(Whitmar)	40.5	52	80
11	A. smithii	(Comm'1)	4	8	29
12	Stiporyzopsis	A-15539	1	0	0
13	Festuca ovina	(USFS)	0.5	0	0
14	Elymus junceus	(Comm'1)	50.5	88	39
15	Elymus triticoides	(Local)	41.5	2	9
16	Oryzopsis hymenoides	A-12242	4	1	2
17	" "	A-14719	8.5	3	0
18	" "	A-16503	16	1	0
19	Bouteloua gracilis	A-12424	0.5	1	0
20	Sporobolus contractus	A-14544	0.5	0	0
21	S. cryptandrus	A-16352	1	3	0
22	Mendora scabra	A-16807	0.5	0	0
23	Purshia glabrata	(USFS)	0	0	0
24	Atriplex canescens	A-16652	0.5	0	0
25	Sanquisorba minor	A-14173	1.5	0	0

Table 17. The species planted in the species observation plots at Fredonia, Arizona on July 9 and October 18, 1965. Values are plants per 100 square feet for the summer seeding.

Plot No.	Species (July seeded)	Source	9/16/65	9/14/66	9/15/67
1	*Agropyron cristatum*	Comm'l Neb. & Montana	1.5	38	21
2	*A. desertorum*	(Nordan)	8	22	17
3	*A. trichophorum*	(Topar)	1	14	3
4	*A. trichophorum*	(Luna)	4.5	45	24
5	*A. intermedium*	A-12496	3	8	2
6	*A. intermedium*	(Greenar)	2.5	15	16
7	*A. smithii*	(Comm'l)	0.5	2	2
8	*A. sibericum*	A-10675	2.0	4	4
9	*A. sibericum*	(Comm'l. Idaho)	5.0	15	6
10	*Elymus juncus*	(comm'l. Montana)	2.5	2	6
11	*Atriplex canescens*	A-16831	0	0	2
12	*Muhlenbergia porteri*	A-13272	0	0	0
13	*Sanquisorba minor*	A-14173	0	0	0
14	*Sporobolus contractus*	A-14544	0	1	0
15	*S. cryptandrus*	(Comm'l. Yuma)	0	0	0
16	*S. airoides*	(Wilcox)	0	0	0
17	*Andropogon ischaemum*	A-14207	3.0	0	0
18	*Leptochloa dubia*	A-14254	0	0	0
19	*Oryzopsis hymenoides*	(Mohave)	1.5	7	3
20	" "	(Holbrook)	0	19	6
21	" "	P-2575	1.0	11	5
22	" "	(Albuquerque)	0	19	3
23	" "	(Shiprock)	0	20	1
24	*Muhlenbergia wrightii*	(Cimmarron)	0	0	0
25	*Tetrachne dregei*	A-14408	0	0	0
26	*Bouteloua curtipendula*	A-3603	4.5	0	0
27	*Eragrostis lehmanniana*	A-14107-108	0	0	0
28	*Bouteloua eriopoda*	A-3730	0	0	0
29	" "	(Naipai)	0.5	0	0
30	*B. gracilis*	(Captan)	0.5	0	0
31	" "	(Comm'l. Colorado)	0	0	0

Table 17 (Continued)

Plot No.	Species (October seeded)	Source	9/14/66	9/15/67
1	*Agropyron cristatum*	(Comm'l. Neb. & Montana)	42	42
2	*A. desertorum*	(Nordan)	40	44
3	*A. trichophorum*	(Topar)	34	34
4	*A. trichophorum*	(Luna)	53	54
5	*A. intermedium*	A-12496	22	21
6	*A. intermedium*	(Greenar)	28	38
7	*A. smithii*	(Comm'l.)	1	5
8	*A. sibericum*	A-10675	3	5
9	*A. sibericum*	(Comm'l. Idaho)	90	80
10	*Elymus juncus*	(Comm'l. Montana)	15	20
11	*Atriplex canescens*	A-16831	4	11
12	*Muhlenbergia porteri*	A-13273	0	0
13	*Sanquisorba minor*	A-14173	2	2
14	*Sporobolus contractus*	A-14544	0	0
15	*S. cryptandrus*	(Comm'l. Yuma)	0	0
16	*S. airoides*	(Wilcox)	0	0
17	*Andropogon ischaemum*	A-14207	0	0
18	*Leptochloa dubia*	A-14254	0	0
19	*Oryzopsis hymenoides*	(Mohave)	30	37
20	" "	(Holbrook)	6	10
21	" "	P-2575	22	11
22	" "	(Albuquerque)	12	17
23	" "	(Shiprock)	12	19
24	*Muhlenbergia wrightii*	(Cimarron)	0	0
25	*Tetrachne dregei*	A-14408	0	0
26	*Bouteloua curtipendula*	A-3603	0	0
27	*Eragrostis lehmanniana*	A-14107-108	0	0
28	*Bouteloua eriopoda*	A-3730	1	0
29	" "	(Naipai)	0	0
30	*B. gracilis*	(Captan)	1	0

Table 18. The species planted in the species observation plots at Fredonia, Arizona on July 9 and October, 1966. Values are plants per 100 square feet for the summer seeding.

Plot No.	July seeded species	Source	Date counted 10/66	Date counted 9/15/67
1	*Agropyron cristatum*	Comm'l.	1	6
2	*A. sibericum*	Comm'l.	1	5
3	*A. sibericum*	P-27	0	5
4	*A. trichophorum*	Luna	3	16
5	*A. trichophorum*	Topar	1	12
6	*A. intermedium*	Greenar	0	3
7	*A. intermedium*	12496	0	8
8	*Elymus junceus*	Comm'l.	0	1
9	*Stipa comata*		0	0
10	*Muhlenbergia wrightii*	Cimarron 8604	0	0
11	*Andropogon ischaemum*	Buckhead 14207	96	6
12	*Sporobolus airoides*	Wilcox 920	0	0
13	*Panicum obtusum*	Pearse 11711	2	0
14	*Oryzopsis hymenoides*	14719 P-2575	0	2
15	" "	Albuquerque 12242	0	2
16	" "	Mohave 14718	0	6
17	" "	Shiprock 16590	0	1
18	" "	Holbrook 16503	0	2
19	*Bouteloua eriopoda*	A-3730	0	3

Plot No.	October seeded species		
1	*Agropyron trichophorum*	Topar	14
2	*A. sibiricum*	P-27	17
3	*A. intermedium*	Greenar	12
4	*A. intermedium*	12496	15
5	*Panicum obtusum*	Pearse 11711	0
6	*Bouteloua curtipendula*		0
7	*Muhlenbergia wrightii*	Cimarron 8604	0
8	*Sporobolus airoides*	Wilcox 920	0
9	*Andropogon ischaemum*	Buckhead 14207	0
10	*Oryzopsis hymenoides*	Shiprock 16590	7
11	" "	Albuquerque 12242	16
12	" "	P-2575	25
13	" "	Holbrook 16503	8
14	" "	Mohave 14718	21
15	*Stipa comata*		1
16	*A. trichophorum*	Luna	130
17	*A. cristatum*	Comm'l.	109
18	*A. sibiricum*	Comm'l.	85
19	*Elumus junceus*	Comm'l.	24
20	*Bouteloua eriopoda*	A-3730	5

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